CLAIMS

1. An ion beam milling system for electron microscopy specimen preparation comprising: a chamber communicating with a source of vacuum for said chamber, first and second ion generating guns positioned in said chamber, a specimen holder, a specimen having length and thickness dimensions, said specimen mounted to said specimen holder, and an ion beam masking member secured to a surface comprising the thickness dimension of said specimen such that there is no relative movement between said specimen and said ion beam masking member during milling, each of said first and second ion guns positioned to cause milling of said surface of said specimen to provide an electron transparent surface of said specimen adjacent said ion beam masking member.

2. An ion beam milling system as claimed in claim 1 in which said ion beam masking member on said surface of said specimen is positioned substantially perpendicular to streams of energized ions and neutrals emitted from said first and second ion generating guns.

3. An ion beam milling system as claimed in claim 1 in which said ion beam masking member is thinned during said milling.

4. An ion beam milling system as claimed in claim 1 in which said ion beam masking member comprises a fiber having a length substantially equal to the length of said specimen.

5. An ion beam milling system as claimed in claim 4 in which said ion beam masking member comprises a material selected from the group consisting of amorphous carbon, graphitic carbon, diamond, silicon carbide, and sapphire.

6. An ion beam milling system as claimed in claim 4 in which said ion beam masking member has a cross section selected from the group consisting of circular, square, rectangular, and elliptical.

7. An ion beam milling system as claimed in claim 4 in which said ion beam masking member has a diameter of from between about 7 to about 100 microns.

8. An ion beam milling system as claimed in claim 7 in which the diameter of said ion beam masking member is pre-milled prior to being secured to said surface of said specimen.

9. An ion beam milling system as claimed in claim 1 including an imaging device adapted for viewing the progress of milling.

10. An ion beam milling system as claimed in claim 9 in which said imaging device comprises a light microscope.

11. An ion beam milling system as claimed in claim 9 in which said imaging device comprises a scanning electron microscope.

12. An ion beam milling system as claimed in claim 1 including a detector adapted to measure the progress of milling.

13. An ion beam milling system as claimed in claim 1 in which said specimen holder is rotatable during milling of said specimen.

14. An ion beam milling system as claimed in 13 including a controller for controlling the power supplied to said ion generating guns.

15. An ion beam milling system as claimed in claim 14 in which power to said ion generating guns is controlled to produce sector ion milling of said specimen.

16. An ion beam milling system as claimed in claim 13 in which said specimen holder is rotatable about a generally vertical axis during milling.

17. An ion beam milling system as claimed in claim 13 in which said specimen holder is rotatable about a generally horizontal axis during milling.

18. An ion beam milling system for electron microscopy specimen preparation comprising: a chamber communicating with a source of vacuum for said chamber, at least one ion generating gun positioned in said chamber, a specimen holder, a specimen having height, length, and thickness dimensions mounted on said specimen holder, and an ion beam masking member secured to a surface comprising the length dimension of said specimen adjacent an edge thereof such that there is no relative movement between said specimen and said ion beam masking member during milling, said at least one ion gun positioned to cause milling of said surface of said specimen to expose an area of interest on said specimen adjacent said ion beam masking member.

19. An ion beam milling system as claimed in claim 18 in which said ion beam masking member on said surface of said specimen is positioned such that streams of energized ions and neutrals emitted from said ion generating gun impinge on said sample to mill said specimen along an edge thereof.

20. An ion beam milling system as claimed in claim 18 in which said ion beam masking member is thinned during said milling.

21. An ion beam milling system as claimed in claim 18 in which said ion beam masking member comprises a fiber having a length substantially equal to the length of said specimen.

22. An ion beam milling system as claimed in claim 21 in which said ion beam masking member comprises a material selected from the group consisting of amorphous carbon, graphitic carbon, diamond, silicon carbide, and sapphire.

23. An ion beam milling system as claimed in claim 21 in which said ion beam masking member has a cross section selected from the group consisting of circular, square, rectangular, and elliptical.

24. An ion beam milling system as claimed in claim 21 in which said ion beam masking member has a diameter of from between about 7 to about 100 microns.

25. An ion beam milling system as claimed in claim 24 in which the diameter of said ion beam masking member is pre-milled prior to being secured to said surface of said specimen.

26. An ion beam milling system as claimed in claim 18 including an imaging device adapted for viewing the progress of milling.

27. An ion beam milling system as claimed in claim 26 in which said imaging device comprises a light microscope.

28. An ion beam milling system as claimed in claim 26 in which said imaging device comprises a scanning electron microscope.

29. An ion beam milling system as claimed in claim18 in which said specimen holder is rotatable.

30. An ion beam milling system as claimed in 18 including a controller for controlling the power supplied to said ion generating guns.

31. An ion beam milling system as claimed in claim 30 in which power to said ion generating guns is controlled to produce sector ion milling of said specimen.

32. An ion beam milling system as claimed in claim 29 in which said specimen holder is rotatable about a generally vertical axis during milling.

33. An ion beam milling system as claimed in claim 18 including a sputtering target positioned in said chamber.

34. An ion beam milling system as claimed in claim 33 in which said ion generating gun is movable from a first position to emit an ion beam towards said specimen to a second position to emit an ion beam towards said sputtering target.

35. An ion beam milling system as claimed in claim 18 including an elevator for moving said specimen and specimen holder from a first specimen exchange position to a second milling position to a third coating position.

36. A method of preparing a specimen for TEM analysis comprising: providing a specimen having length and thickness dimensions, mounting said specimen to said specimen holder, securing an ion beam masking member to a surface comprising the thickness dimension of said specimen, evacuating a chamber, positioning said specimen in said chamber, milling said surface of said specimen to provide an electron transparent surface of said specimen adjacent said ion beam masking member such

that there is no relative movement between said specimen and said ion beam masking member.

37. A method as claimed in claim 36 in which said ion beam masking member comprises a fiber having a length substantially equal to the length of said specimen.

38. A method as claimed in claim 37 in which said ion beam masking member comprises a material selected from the group consisting of amorphous carbon, graphitic carbon, diamond, silicon carbide, and sapphire.

39. A method as claimed in claim 37 in which said ion beam masking member has a cross section selected from the group consisting of circular, square, rectangular, and elliptical.

40. A method as claimed in claim 37 in which said ion beam masking member has a diameter of from between about 7 to about 100 microns.

41. A method as claimed in claim 40 including premilling the diameter of said ion beam masking member prior to being secured to said surface of said specimen.

42. A method as claimed in claim 36 including measuring the progress of milling as said milling takes place.

43. A method as claimed in claim 42 in which the progress of milling is measured using a light microscope.

44. A method as claimed in claim 42 in which the progress of milling is measured using a scanning electron microscope.

45. A method as claimed in claim 42 in which said ion beam masking member is electrically conductive and the progress of milling is measured by measuring changes in electrical resistance of the masking member.

46. A method as claimed in claim 36 including rotating said specimen holder during milling of said specimen.

47. A method as claimed in claim 46 including rotating said specimen holder about a generally vertical axis during milling of said specimen.

48. A method as claimed in claim 46 including rotating said specimen holder about a generally horizontal axis during milling of said specimen.

49. A method as claimed in claim 46 including performing sector ion milling of said specimen by controlling the power supplied to said ion generating guns.

50. A method as claimed in claim 46 in which the speed of rotation of said specimen holder is varied.

51. A method of preparing a specimen for SEM analysis comprising: providing a specimen having length and thickness dimensions, mounting said specimen to said specimen holder, securing an ion beam masking member to a surface comprising the length dimension of said specimen, evacuating a chamber, positioning said specimen in said chamber, milling said surface of said specimen to cause milling of said surface of said specimen to expose an area of interest on said specimen adjacent said ion beam masking member such that there is no relative movement between said specimen and said ion beam masking member.

52. A method as claimed in claim 51 in which said ion beam masking member on said surface of said specimen is positioned such that streams of energized ions and neutrals emitted from said ion generating gun impinge on said sample to mill said specimen along an edge thereof.

53. A method as claimed in claim 51 in which said ion beam masking member is thinned during said milling.

54. A method as claimed in claim 51 in which said ion beam masking member comprises a fiber having a length substantially equal to the length of said specimen.

55. A method as claimed in claim 54 in which said ion beam masking member comprises a material selected from the group consisting of amorphous carbon, graphitic carbon, diamond, silicon carbide, and sapphire.

56. A method as claimed in claim 54 in which said ion beam masking member has a cross section selected from the group consisting of circular, square, rectangular, and elliptical.

57. A method as claimed in claim 54 in which said ion beam masking member has a diameter of from between about 7 to about 100 microns.

58. A method as claimed in claim 57 including premilling the diameter of said ion beam masking member prior to securing said ion beam masking member to said surface of said specimen.

59. A method as claimed in claim 51 including viewing the progress of milling as said milling takes place.

60. A method as claimed in claim 59 including using a light microscope to measure the progress of milling.

61. A method as claimed in claim 59 including using a scanning electron microscope to measure the progress of milling.

62. A method as claimed in claim 59 in which said ion beam masking member is electrically conductive and the electrical resistance of said masking member is measured to measure the progress of milling.

63. A method as claimed in claim 51 including rotating said specimen holder about a generally vertical axis during milling of said specimen.

64. A method as claimed in claim 51 including rotating said specimen holder during milling.

65. A method as claimed in claim 51 including positioning a sputtering target in said chamber.

66. A method as claimed in claim 65 including moving said ion generating gun from a first position after milling said specimen to a second position to emit ions toward said sputtering target to sputter coat said specimen.

67. A method as claimed in claim 51 including moving said specimen and specimen holder from a first specimen exchange position to a second milling position to a third coating position.